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ACM SIGGRAPH has long been one of the year's most visible technical conferences. Since its humble origins 29 years ago it has repeatedly grown to attract tens of thousands of attendees and hundreds of companies from around the globe. SIGGRAPH has been shrinking somewhat in recent years due to a number of factors, but this year's event in San Antonio still offered more than any one person could absorb during its weeklong existence.

The ACM SIGGRAPH conference is the most visible manifestation of the Association for Computing Machinery's Special Interest Group on Graphics and Interactive Techniques. It is by far the largest of any of the ACM's yearly events. SIGGRAPH attracts researchers, students, developers, scientists, artists, engineers, movie studios, game companies, hardware vendors, and software authors for an annual peek at what has been discovered in the last year and what advancements will be showing up in the future. The conference, which includes discussion panels, courses, and presentations of papers and applications, lasts a week. The exhibition of up and coming visual technologies lasts a very busy three days.

What was noteworthy about this year's SIGGRAPH? As mentioned earlier, attendance was in decline – though you might not think so, wandering among the crowd of 17,000 attendees. Photorealism – being able to digitally mimic real-world phenomena as they are recorded by film – has been achieved in virtually every area. Even daunting challenges such as human skin, splashing liquids, and natural lighting have been vanquished. There will no doubt continue to be many significant improvements in the future, but the frontier of photorealism that drove work in computer graphics for years is now nearly fenced off.

Hardware advances were prominently visible this year. A number of researchers presented techniques that take advantage of the unprecedented availability and power of hardware graphics acceleration. If last year's hardware was impressive, next year's will be stunning. Matrox was demonstrating their new line of "Parhelia" video cards, the first affordable system to

deliver 10 bits of color information to users' displays, giving 1024 intensity steps for each color channel as opposed to the long-accepted 256 of "truecolor" displays. ATI definitely had the most jaw-dropping consumer hardware on display. Its new Radeon 9700 allows colors and textures to be processed internally with floating-point color depth and output with 10 bits per channel, similar to Parhelia. The internal processing pipeline allows some truly cinematographic effects to be produced in realtime. Paul Debevec's 1998 "Rendering with Natural Light", a groundbreaking piece of work that took more than 30 minutes per frame to render at the time, was reproduced in realtime on the Radeon 9700 demo machine. The 9700′s output is gorgeous and must be seen to be appreciated. It struck me as the greatest qualitative advance in consumer graphics hardware since the original GeForce. Speaking of the GeForce, ATI has leapfrogged its rival for now but Nvidia will be trying to return the favor in a few months with their upcoming NV30 design. Nvidia's demos weren't as impressive as ATI's, but it is certain that neither company will be resting on their laurels over the next few months.

Apple hardware had a minor but noticeable presence at this year's exhibition. It was used to demo the latest versions of video editors Final Cut Pro and Avid Xpress DV and compositor Shake in rotating shifts at the ProMax booth. Shake's future outside of OS X is uncertain since its acquisition by Apple, although it will be half as expensive as before if you're willing to run it on a Mac. Nobody would comment on the future of Rayz, the other high-end compositing package recently acquired by Apple. Final Cut Pro and Xpress DV both have some significant improvements over their previous versions, especially in the area of real-time effects. Adobe was also demonstrating its products on Macs as well as Windows machines, and a number of video-oriented companies were offering products with Macintosh compatibility.

Linux showed up on the exhibit floor to a greater extent than I expected. Many hardware vendors already had Linux-compatible products or were soon going to be offering drivers for the free operating system that is seen by many as the successor to Irix in the visual-effects world. In fact, it seemed that more vendors were promising Linux comptability than Macintosh compatibility – an ominous sign if Apple wants to be the king of graphics. Most of the machines used by presenters were PCs running Windows and PowerPoint, but one courageous soul from Digital Domain demonstrated work he'd done for *The Fellowship of the Ring* using KPresenter on his Linux laptop. Unfortunately for him, the laptop and projector did not seem to get along, leading to an annoying flicker. Softimage, SideFX Software, Alias|Wavefront, Pixar, Digital Domain, and many others were offering Linux versions of their software. SideFX was giving away free CDs containing an "apprentice edition" of their newest Houdini version. Unlike most demos, this one can actually do useful work. It saves files in a special format, rendered images have a small watermark, and output is limited to 640×480, but almost all aspects of the software can be learned and explored by students and prospective buyers before committing to a purchase. Other vendors could take promotional lessons from SideFX.

More than fast new hardware or the latest software updates, advancements in computer graphics depend on fresh new ideas. The aforementioned conquering of the photorealism frontier has left a sort of void in the computer graphics community, one that has yet to be filled. One

possible effect of the sudden lack of challenges is that researchers will focus more on the effective use of computer graphics techniques instead of developing new techniques. The panel session entitled “The Future of Computer Graphics: An Enabling Technology?” explored a few of the ways more ubiquitous computing and graphical displays could be used, from showing what’s in the refrigerator without opening the door to better understanding scientific simulations. I believe it was Bill Buxton, chief scientist of Alias|Wavefront, who made the point that the common measures of “goodness” of computers tell us nothing about how effectively they are used. Network bandwidth, memory bandwidth, math operations per second – all these numbers are going up. Unfortunately, Moore’s law guarantees nothing about how effectively humans use computers. New metrics are needed, ones that focus on the ability of people to accomplish useful work with their computer systems rather than the raw hardware capabilities of the system.

While watching presentations from various leading cinematic visual effects and animation companies I was struck by how right Baxton was. Many of these companies are still using older versions of software on old SGI machines, machines that would be blown away in sheer speed by any modern PC. But the artists are used to working with these machines and with the custom tools that have grown around them over years. And in the end, it’s these skilled workers’ productivity that matters more than whether or not the hardware and software they are using is the fastest and newest. Even when upgrades finally come they’re to newer Unix machines that will support the established work patterns and custom aids that the users are accustomed to. One wonders if other industries might do well to reconsider riding the perennial upgrade bandwagon.

Various presentations impressed with how far ahead of culture technology continues to race. Goals of photorealism in computer graphics have been met too rapidly for general visual literacy to keep up. “Don’t believe everything you see” needs to become as familiar as “don’t believe everything you read.” Salon.com features a recent review of the movie “XXX” that includes lavish praise for the cinematographer’s skill in shooting a scene of an avalanche. The reviewer didn’t realize that the avalanche was virtual, created on computers at visual effects company Digital Domain. Audiences also might think Vin Diesel is an especially macho action star for doing all his own stunts, not realizing that even alert viewers can be fooled by the latest digital techniques for replacing faces and bodies. This year’s paper Trainable Videorealistic Speech Animation demonstrated how to use recorded video sequnces to synthesize realistic video of a person saying things they have never said. The authors are aware of the potential uses and abuses of their system, but how many others are? “The recorded subjects can be regular people, celebrities, ex-presidents, or infamous terrorists.”

The camera has always been an accomplished liar. Before the digital techniques that have become widespread in the last decade, optical and chemical tricks let people fake images of fairies, aliens, and flying cars. Even unaltered photographs can be used to propagate a lie. What they don’t show can be as important as what they do show. But we are rapidly approaching a point where pictures of Osama bin Laden and the Loch Ness Monster need to be studied with equal skepticism.

The newest techniques complete a trend that began more than a century ago. It used to be that even a dedicated, extremely skilled group of workers at a facility such as Industrial Light and Magic couldn't produce illusions that were indistinguishable from reality. Space ships would have telltale black matte lines around them. Actors would have different lighting than their surroundings. Monsters would move with the strange jerking of stop-motion animation. It didn't really matter because the images only had to be good enough for the audience to suspend disbelief.

Today, synthetic elements representing almost anything can be seamlessly integrated with real footage, beyond the abilities of even the most attentive watcher to detect. Clever enough images don't need the viewer's cooperation to suspend disbelief. Tomorrow, the most popular file on the Internet might be some teen's video of Frank Sinatra and Saddam Hussein singing a duet in the Oval Office. The future certainly holds surprises for the unwary.

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